Patent claims

1. A method for the production of monodisperse acrylic-containing ion exchangers, characterized in that

a) a noncrosslinked monodisperse seed polymer having a particle size of 0.5 to 20 µm is produced by free-radical-initiated polymerization of monoethylenically unsaturated compounds in the presence of a nonaqueous solvent,

b) to a nonaqueous dispersion of the seed polymer in the presence of a dispersant a monomer feed is added which contains

0.1 to 2% by weight of initiator,
1 to 60% by weight of crosslinker and
30 to 98.9% by weight of acrylic monomer, of which up to 49.9% by weight can be replaced by styrene,

the monomer feed is allowed to swell into the seed and at elevated temperature is polymerized to give crosslinked monodisperse acrylic-containing bead polymers, preferably having a particle size of 5 to 500 µm, and

c) these crosslinked monodisperse acrylic-containing bead polymers are converted by functionalization into monodisperse acrylic-containing ion exchangers.

2. A monodisperse acrylic-containing ion exchanger obtainable by

a) producing a noncrosslinked monodisperse seed polymer having a particle size of 0.5 to 20 µm by free-radical-initiated polymerization of monoethylenically unsaturated compounds in the presence of a nonaqueous solvent,

b) adding a monomer feed to an aqueous dispersion of the seed polymer in the presence of a dispersant, the monomer feed containing

0.1 to 2% by weight of initiator,
1 to 60% by weight of crosslinker and
30 to 98.9% by weight of acrylic monomer, of which up to 49.9% by weight can be replaced by styrene,

swelling the monomer feed into the seed and polymerizing at elevated temperature to give crosslinked monodisperse acrylic-containing bead polymers, preferably having a particle size of 5 to 500 µm, and

c) functionalizing these crosslinked monodisperse acrylic-containing bead polymers.

3. A monodisperse acrylic-containing bead polymer, preferably having a particle size of 5 to 500 µm, obtainable by

a) producing a noncrosslinked monodisperse seed polymer having a particle size of 0.5 to 20 µm by free-radical-initiated polymerization of monoethylenically unsaturated compounds in the presence of a nonaqueous solvent,

b) adding a monomer feed to an aqueous dispersion of the seed polymer from method step a) in the presence of a dispersant, the monomer feed containing

0.1 to 2% by weight of initiator,
1 to 60% by weight of crosslinker and
30 to 98.9% by weight of acrylic monomer, of which up to 49.9% by weight can be replaced by styrene,

swelling the monomer feed into the seed and polymerizing at elevated temperature.

4. A method for the production of monodisperse acrylic-containing ion exchangers, characterized in that

a) a noncrosslinked monodisperse seed polymer having a particle size of 0.5 to 20 µm is produced by free-radical-initiated polymerization of

monoethylenically unsaturated compounds in the presence of a nonaqueous solvent,

a') to an aqueous dispersion of the seed polymer from a), in the presence of a dispersant, at least one monomer feed is added which contains 0.1 to 5% by weight of initiator and 95 to 99.9% by weight of monoethylenically unsaturated compounds but no crosslinker, allowing the monomer feed to swell into the seed and polymerizing,

b) to a nonaqueous dispersion of the seed polymer from method step a') in the presence of a dispersant a monomer feed is added which contains

0.1 to 2% by weight of initiator,
1 to 60% by weight of crosslinker and
30 to 98.9% by weight of acrylic monomer, of which up to 49.9% by weight can be replaced by styrene,

the monomer feed is allowed to swell into the seed and at elevated temperature is polymerized to give crosslinked monodisperse acrylic-containing bead polymers, preferably having a particle size of 5 to 500 μm, and

c) these crosslinked monodisperse acrylic-containing bead polymers are converted by functionalization into monodisperse acrylic-containing ion exchangers.

5. A monodisperse acrylic-containing ion exchanger obtainable by

a) producing a noncrosslinked monodisperse seed polymer having a particle size of 0.5 to 20 μm by free-radical-initiated polymerization of monoethylenically unsaturated compounds in the presence of a nonaqueous solvent,

a') adding at least one monomer feed to an aqueous dispersion of the seed polymer from a) in the presence of a dispersant, this monomer feed containing 0.1 to 5% by weight of initiator and 95 to 99.9% by weight of monoethylenically unsaturated compounds but no crosslinker, allowing

the monomer feed to swell into the seed and polymerizing to give a crosslinked monodisperse bead polymer at elevated temperature,

b) adding a monomer feed to an aqueous dispersion of the seed polymer from method step a') in the presence of a dispersant, the monomer feed containing

0.1 to 2% by weight of initiator,
1 to 60% by weight of crosslinker and
30 to 98.9% by weight of acrylic monomer, of which up to 49.9% by weight can be replaced by styrene,

swelling the monomer feed into the seed and polymerizing at elevated temperature to give crosslinked monodisperse acrylic-containing bead polymers, preferably having a particle size of 5 to 500 µm, and

c) functionalizing these crosslinked monodisperse acrylic-containing bead polymers.

6. A monodisperse acrylic-containing bead polymer, preferably having a particle size of 5 to 500 µm, obtainable by

a) producing a noncrosslinked monodisperse seed polymer having a particle size of 0.5 to 20 µm by free-radical-initiated polymerization of monoethylenically unsaturated compounds in the presence of a nonaqueous solvent,

a') adding at least one monomer feed to an aqueous dispersion of the seed polymer from a) in the presence of a dispersant, the monomer feed containing 0.1 to 5% by weight of initiator and 95 to 99.9% by weight of monoethylenically unsaturated compounds but no crosslinker. Allowing the monomer feed to swell into the seed and polymerizing to give a noncrosslinked bead polymer at elevated temperature.

b) adding a monomer feed to an aqueous dispersion of the seed polymer from method step a') in the presence of a dispersant, the monomer feed containing

0.1 to 2% by weight of initiator,

1 to 60% by weight of crosslinker and

30 to 98.9% by weight of acrylic monomer, of which up to 49.9% by weight can be replaced by styrene,

swelling the monomer feed into the seed and polymerizing at elevated temperature.

7. The method as claimed in claims 1 or 4, characterized in that the monomer feed in method step b) is added in the form of a finely divided aqueous emulsion.

8. The monodisperse acrylic-containing bead polymer as claimed in claim 6, characterized in that, in method step a), as monoethylenic compound, styrene and in method step a') at least one monomer feed contains between 20 and 49.9% styrene.

9. A method for the production of monodisperse weakly acidic cation exchangers, characterized in that, in method step c) of claims 1 and 4, the monodisperse acrylic-containing bead polymers from method step b) are hydrolyzed by strong bases or strong acids.

10. A method for the production of anion exchangers, characterized in that the monodisperse, acrylic-containing bead polymers obtained according to method step b) of claims 1 and 4 are reacted in method step c) with diamines or aminoalcohols.

11. The use of the monodisperse acrylic-containing cation exchangers obtainable as claimed in claim 9

- for removing cations, color particles or organic components from aqueous or organic solutions,
- for softening in neutral exchange of aqueous or organic solutions,
- for purification and workup of waters of the chemical industry, the electronics industry and from power stations,

- for decolorizing and desalting wheys, low-viscosity gelatin broths, fruit juices, fruit musts and aqueous solutions of sugars,

- for separating off and purifying biologically active components such as, for example, antibiotics, enzymes, peptides and nucleic acids from their solutions, for example from reaction mixtures and from fermentation broths,

- for analysis of the ion content of aqueous solutions by ion-exchange chromatography.

12. The use of the monodisperse acrylic-containing anion exchangers obtainable as claimed in claim 10

- for removing anions from aqueous or organic solutions and their vapors

- for removing color particles from aqueous or organic solutions and their vapors,

- for decolorizing and desalting glucose solutions, wheys, low-viscosity gelatin broths, fruit juices, fruit musts and sugars, preferably mono- or disaccharides, in particular cane sugar, beet sugar solutions, fructose solutions,

- for removing organic components from aqueous solutions, for example humic acids from surface water,

- for separating off and purifying biologically active components such as, for example, antibiotics, enzymes, peptides and nucleic acids from their solutions, for example from reaction mixtures and from fermentation broths,

- for analysis of the ion content of aqueous solutions by ion-exchange chromatography.

13. The use of the monodisperse, acrylic-containing bead polymers obtainable as claimed in claim 3 or 6

- for separating off and purifying biologically active components such as, for example, antibiotics, enzymes, peptides and nucleic acids from their solutions, for example from reaction mixtures and from fermentation broths,

- for removing color particles or organic components from aqueous or organic solutions,

- as support for organic molecules such as chelating agents, enzymes and antibodies.